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PEDOLOGICAL INVESTIGATION OF THE HIGGINS SITE

By

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INTRODUCTION

A pedological investigation of the Higgins Site (18AN489) in northwestern Anne Arundel County was conducted on March 8, 1988. The investigation was directed toward the examination and interpretation of soil profiles and landscapes in the site area. Stratigraphy and geomorphological relationships were evaluated for evidence of former surface levels and deposit ages. In these efforts interpretations of soil profile development were of principal importance, since soil profiles offer records of the past derived from the weathering of geologic parent materials over time. Because mature soil profiles owe many of their characteristics to weathering processes acting during intervals of relative surface stability, degree of soil profile development may be related to degree of deposit stability, and where sufficient subsoil development has occurred, can suggest approximate ages for deposits. Hence, within the context of soil-landscape relationships, soil profiles may be interpreted as indicators of depositional histories, land surface ages, and environmental conditions.

The method of investigation consisted entirely of field observations. These observations entailed the description of soil profiles exposed in test pits. Soil profiles were described using standard techniques and nomenclature for the field descriptions of soils. Descriptions of the soil profiles observed are contained in Appendix A.

GEOLOGIC SETTING

The study area is located within the upper reaches of the Coastal Plain Physiographic Province of Maryland. Soil parent materials in the region therefore consist of the unconsolidated sedimentary deposits typifying the Maryland Coastal Plain. As identified on the Geologic Map of Anne Arundel County (Glaser, John D. 1976. Maryland Geological Survey), the dominant site geology consists of the silt-clay facies of the Potomac Group of sediments. These Lower Cretaceous deposits are among the most ancient of Coastal Plain deposits and are extensive throughout northern Anne Arundel County.

Associated with the silt-clay facies, and often not readily separable at the scale of most geological maps, are more coarse-textured deposits which may represent either the sand-gravel facies of the Potomac Group or terrace deposits of Pleistocene age. Thin, Pleistocene surface mantles of only a few feet in thickness are not normally recognized in geological surveys, but such deposits can be of principal importance from the perspectives of pedology and archeology. More coarse-textured caps of probable Pleistocene age have been found to commonly overlay Cretaceous clay deposits (Wagner, D.P. 1976. Soils associated with the reddish Cretaceous clays of Maryland. M.S. Thesis. University of Maryland), and Pleistocene deposits are in fact identified on the Geologic Map of Anne Arundel County along the western slopes of the Stony Run valley opposite from the site location. These deposits occur at elevations corresponding to

the surface elevations of the Higgins site, but were apparently of sufficient thickness to warrant delineation only along the western side of Stony Run.

The observations of this study are in general concurrence with the Geologic Map of Anne Arundel County, and from the identification of Lower Cretaceous strata at lower levels in three of the four test pits examined, it is apparent that the site landform is composed dominantly of Lower Cretaceous Coastal Plain sediments. However, these lower strata are of little archeological significance, and upper soil horizons are clearly formed in more recent, sandy deposits. It is most likely that these upper deposits owe their primary origin to Pleistocene terrace formation, but there is also little doubt that these deposits have undergone near-surface alterations and reworking throughout the Holocene and possibly during later phases of the Pleistocene.

PEDOLOGY AND GEOMORPHOLOGY

The Higgins Site is distributed across a landform best characterized as a Coastal Plain upland. This upland occurs as an interfluv between Stony Run to the west and Kitten Creek, a tributary to Stony Run, to the east. The confluence of Stony Run and Kitten Creek occurs in a swampy setting some 500 m north of the site. Swampy terrain occupies both the Kitten Creek drainageway as well as the much broader valley floor of Stony Run. Much of the formerly swampy landscape intervening the site

area and the confluence of the two streams has been modified and is now occupied by the Amtrack station and parking lot.

Slopes across the site fall mostly eastward or westward toward the two stream, although both northern and southern declinations are encountered on opposing ends of the site. The highest landscape positions generally occur along a ridge line at the crest of the moderately steep ($>15\%$) slopes falling some 10 m toward Stony Run. Hence, the predominant site grade is across the longer but more gentle (3 to 5 %) slopes leading to Kitten Creek.

* The steepness of the slopes along the western flank of the site is indicative of undercutting of the landform either by Stony Run or, more likely, by an ancestral precursor to Stony Run. Such lateral landscape truncation could also account for the apparently more extensive Pleistocene terrace remnants along the western valley wall, suggesting that the channel flows responsible for undercutting were mainly directed against the eastern side of the valley, and removed all but the highest of the Pleistocene deposits.

Soil profile development is largely confined to the upper, sandy strata and does not generally reach into the underlying, clayey substrata. As observed in the test pits examined, soil profiles lithologically consist of sandy horizons having combined total thicknesses of as much as 150 cm above dense, clayey substrata. Along the lowest landscape positions or in localized

areas of disturbance, thicknesses of the sandy horizons could well be greater.

Degree of soil profile development is mostly weak. Although argillic (Bt) subsoil horizons were identified in each of the test pits examined, the degree of expression of these pedogenetically clay-enriched horizons was weak. Indeed, in pit 3 and along one wall of pit 6 it was unclear by field examination as to whether an argillic horizon was actually present. Recognizing degree of argillic horizon development is often an important indication of soil age, since under humid-temperate climatic conditions, a minimum of several thousand years of weathering acting on relatively stable landscapes is necessary for argillic horizon formation. With increasing time degree of argillic horizon development also increases. Unfortunately, time is not the sole variable in soil genesis, and site-specific conditions often limit the utility of age estimations based on extrapolations from regional observations.

The very sandy nature of the Higgins Site soils would greatly tend to reduce rates of soil development from projections based on more loamy-textured parent materials. Given a large concentration of essentially inert quartz and a correspondingly low concentration of more weatherable minerals, some pedogenetic transformations are almost negligible in very sandy soils, even with very great age. Iron release from primary minerals, as evidenced by reddish (7.5YR and 5YR) colors, and slight subsoil clay increases to form weak argillic horizons are the principal pedogenetic alterations in the site soils. Whereas these

characteristics might require as much as 3,000 to 4,000 years to be achieved in more weatherable, loamy material, weathering intervals of perhaps two to three times longer or more can readily be considered for the site soils.

Even though the basic site landform is likely to date well into the Pleistocene, and some subsoil horizons have probably been essentially stable throughout the Holocene, the uppermost sandy horizons have been subject to changes during the Holocene and up to the present. A number of observations attest to Holocene and historic alterations of surface and near-surface horizons on the site. Chief among these are buried stone lines marking former erosional surfaces. Such linear concentrations of gravel and ironstone fragments were observed in three (2, 3 and 6) of the four test pits examined. As lag deposits of coarse fragments remaining after differential erosional depletion of finer soil fractions, the stone lines represent levels of land surface truncation. Since the stone lines observed were below depths ranging from about 50 to 75 cm, these lines not only indicate episodes of erosion but also subsequent episodes of deposition. Additionally, soil development is always more strongly expressed below stone lines and is limited to surface (A) and weak subsoil (Bw) or transitional (BE) horizons above them. Such soil morphological patterns are indicative of multiple and separate periods of relative landscape stability which allow for soil formation.

Variations in depths to argillic horizons across the site are also suggestive of soil erosion and deposition. Depths to argillic horizons in higher landscape positions were observed to be less than those in the lower positions. The relationship between the soils observed in pits 4 and 6 demonstrate this variation. Lying at a higher landscape position than pit 6, pit 4 contained an argillic horizon at the depth of 49 cm. In pit 6 the depth to the argillic horizon was 72 cm. Such a relationship is common on gently sloping Coastal Plain landscapes and can be credited to long-term erosional processes whereby soil materials are lost from upper landscape positions and are accumulated in lower positions.

The process of down slope movement of soil particles by erosion is usually vastly accelerated when landscapes are cleared and cultivated. Evidence for this is typically revealed by a pattern of over-thickened A horizons along slope bases and the incorporation of subsoil material into plow layers of soils near slope crests. This pattern was not strongly evidenced on the site, and an overthickened A horizon was observed only at a point near test pit 2 where a small swale or gully has undergone filling. The absence of this typical trend may indicate that even though the site has been historically farmed, actual tilling of the land was relatively infrequent; and pasturing may have been the more prevalent land use. Infrequent attempts at crop production would be compatible with the poor native fertility of the sandy soils.

Although not observed in this investigation, reported earlier findings of superimposed plow layers along the ridge crest on the western side of the site are counter to normal trends of soil loss from plowed, high landscape positions. It is suggested that the thicker surface horizons along the ridge edge may be evidence of a former field boundary. Such a position would be a logical location for a fence row, and field edges or fence rows tend to accumulate soil, particularly if the adjacent field is undergoing plowing. Conventional moldboard plows lift and laterally displace soil. In field centers the soil displacement is canceled out between consecutive furrows, but along field edges there is a net displacement toward the edge. Since field edges are often missed by the plow, they may receive soil displaced from adjacent furrows and yet suffer no compensating loss.

Options for the available mechanisms by which soil has been transported to or across the site are rather limited. Lying well above the adjacent streams, fluvial deposition or erosion by Holocene flooding of the site landscape is clearly not a consideration. Similarly, although localized areas of concentrated erosion and deposition from such historic activities as farming and machinery or animal trafficking would be expected, these mechanisms would not account for much beyond surface horizon alterations. The only viable remaining mechanisms are therefore either slope wash or eolian processes. Of these, eolian transport is likely to be the least significant.

As determined from field textures the average size of sand grains is too coarse to indicate a primary eolian origin for the sands. Additionally, small pebbles and gravels were observed to be generally scattered throughout the sandy deposits. Hence, appreciable eolian additions of materials derived from outside the immediate site area are not likely. Tendencies displayed in surface horizons (up to 30 cm depth) for finer sand size and fewer pebbles would be compatible with localized eolian reworking of the uppermost soil layers.

Slope wash, which would include sheet wash, soil creep, and very likely rill and minor gully cutting, is the most probable mechanism for the observed soil truncations and deposition. Medium to coarse sand grain sizes and the presence of pebbles and gravels in the sandy soils are suggestive of low velocity, water-transport. Slope wash processes are normally very slow but are generally acknowledged to be major agents in the denudation of nearly all upland surfaces. Their effect on a landscape is the loss of material from higher positions with accompanying gain at lower levels. As previously described, varying depths to argillic horizons across the site are supportive of this effect.

During periods of sparse vegetative cover due to drought or fire, slope wash actions can be greatly accelerated, and more rapid truncations and burials of land surfaces can occur. Such periods of more severe erosion would be indicated by the detection of former gullying, and an apparently filled gully or swale was observed in the area adjacent to pit 2 and extending toward pit 1. The former gully is evidenced by the lateral

truncation of the moderately developed argillic horizon present in pit 2. Other evidence which would assist in identifying former gully areas would be buried gravelly layers, however, these were not detected in this investigation. Most probably, shallow gully formation and subsequent filling are likely to have occurred at various times and locations across the site.

SUMMARY

The Higgins Site occupies a Coastal Plain upland composed mainly of Lower Cretaceous sediments but capped by a surficial veneer of Pleistocene sands. Soil development in the sands is mostly weak, however, due to the relative inertness of the deposit to weathering, some subsoil layers may be indicative of stable weathering histories extending to the Pleistocene. Holocene disturbances of the soils have resulted in soil truncations and reburials. These alterations are likely to have been caused primarily by slope wash processes. Eolian action could have contributed to localized reworking of the uppermost layers, but particle sizes in the sandy deposits are more compatible with a water-borne origin for the sands rather than eolian.

APPENDIX A

Soil Profile Descriptions

ABBREVIATIONS AND NOTATION

CONSISTENCE	DRAINAGE
L loose	VERY POOR gleyed below thick dark surface
VFR very friable	POOR gleyed below surface
FR friable	SOMEWHAT POOR mottled 8 to 18 inches below surface
FI firm	MODERATELY WELL mottled 18 to 36 inches below surface
VFI very firm	WELL not mottled above 36 inches below surface
EFI extremely firm	EXCESSIVELY WELL same as well drained with textures of loamy sand or coarser throughout profile

MOTTILING

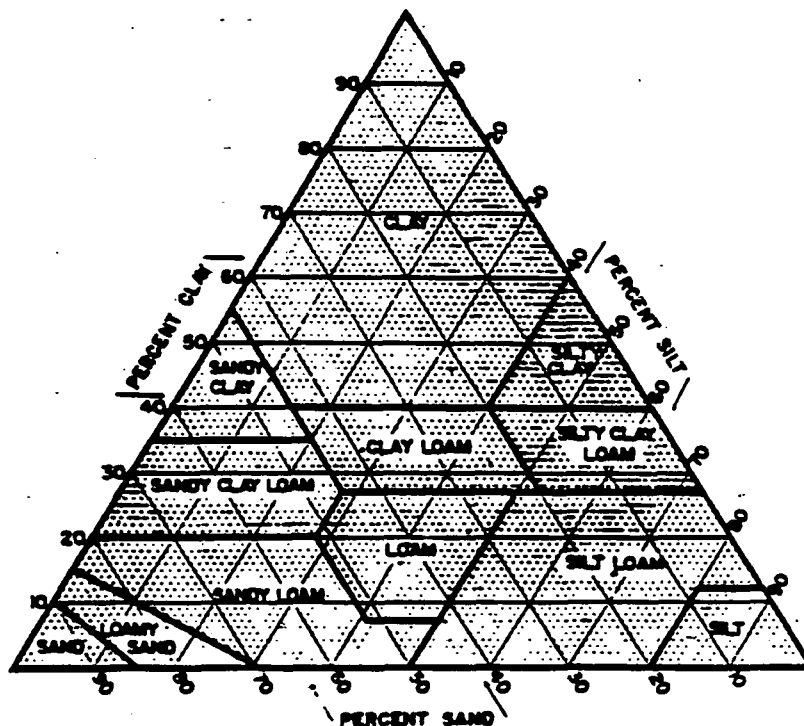
Abundance	Size	Contrast
F few = less than 2% of area	1 fine = less than 5 mm	F faint
C common = 2-20% of area	2 medium = 5-15 mm	D distinct
M many = over 20% of area	3 large = over 15 mm	P prominent

example: C2D = common medium distinct mottles

TEXTURE

S Sand
 LS Loamy sand
 SL Sandy loam
 L Loam
 SIL Silt loam
 SI Silt
 SILCL Silty clay loam
 CL Clay loam
 SCL Sandy clay loam
 SC Sandy clay
 C Clay
 SIC Silty clay

F Fine
 CO Coarse
 VCO Very coarse
 G Gravelly



SOIL DESCRIPTION

Client _____ Job No. 88738 Described By DFW Date 3/8/18

[illegible]

SOIL DESCRIPTION

Client _____ Job No. 88438 Described By DPW Date 3/8/88

Observation No.		Type <u>BORING</u>		Location <u>RESIDE TEST PIT 2 TOWARD TEST PIT 1</u>						
Map Symbol		Classification						Series		
Landscape Position						Parent Material				
Slope <u>3%</u>		Relief		Drainage				Water Table		
Vegetation										
Horizon	Depth CM	Boundary	Texture	Structure	Color	Mottling		Consistence	Rx.	Other Features
<u>Ap1</u>	<u>0-15</u>		<u>LS</u>		<u>10YR3/3</u>			<u>VFR</u>		} <u>FINER SANDS</u>
<u>Ap2</u>	<u>15-28</u>		<u>LS</u>		<u>10YR4/4</u>			<u>VFR</u>		
<u>Bw1</u>	<u>28-58</u>		<u>LS</u>		<u>7.5YR5/6</u>			<u>VFR</u>		
<u>Bw2</u>	<u>58-74</u>		<u>S</u>		<u>7.5YR5/6</u>			<u>L</u>		<u>IRONSTONE AT BASE</u>
<u>2Bt</u>	<u>74-104</u>		<u>SL-SCL</u>		<u>5YR5/8</u>			<u>FR</u>		
<u>3C</u>	<u>104-135</u>		<u>CL</u>		<u>2.5YR4/8</u>	<u>M2P</u>	<u>10YR7/2</u> <u>10YR5/6</u>	<u>F1</u>		<u>IRONSTONE FRAGS.</u>
		<u>AUGER REFUSAL IRONSTONE</u>								
Additional Notes <u>TEST PIT 1 SHOULDER POSITION 4% ~75' FROM SLOPE</u>										
<u>GREATER DEPTH TO ARGILLIC SUGGESTS FILLED SWALE</u>										

SOIL DESCRIPTION

Client _____ Job No. 88438 Described By DPW Date 3/8/88

Observation No.		Type		Location <u>TEST PIT 3</u>						
Map Symbol <u>FRS 1-3</u>		Classification						Series		
Landscape Position <u>UPLAND</u>				Parent Material <u>COASTAL PLAIN SEDIMENTS</u>						
Slope <u>2-3%</u>		Relief		Drainage <u>WELL</u>				Water Table		
Vegetation <u>MIXED PINE WOODS</u>										
Horizon	Depth CM	Boundary	Texture	Structure	Color	Mottling		Consistence	Rx.	Other Features
<u>A</u>	<u>0-8</u>	<u>CS</u>	<u>LS</u>	<u>1MSBK</u>	<u>10YR 2/2</u> <u>AND</u> <u>10YR 2/2</u>			<u>VFR</u>		
<u>Ap</u>	<u>8-24</u>	<u>AS</u>	<u>LS</u>	<u>OM</u>	<u>10YR 3/3</u>			<u>VFR</u>		
<u>BE1</u>	<u>24-54</u>	<u>CS</u>	<u>LS</u>	<u>OM</u>	<u>7.5YR 4/4</u>			<u>VFR</u>		
<u>BE2</u>	<u>54-79</u>	<u>CS</u>	<u>LS</u>	<u>OM</u>	<u>7.5YR 4/6</u>			<u>VFR</u>		
<u>Bx1</u>	<u>79-107</u>	<u>CS</u>	<u>LS</u>	<u>OM →</u> <u><1VCOSBK</u>	<u>5YR-7.5YR</u> <u>4/6</u>			<u>VFR</u>		<u>ISOLATED PED FACES WITH</u> <u>SOME CLAY BRIDGING</u>
<u>C</u>	<u>107-150</u>		<u>S</u>	<u>OSG</u>	<u>7.5YR 6/6</u>			<u>L</u>		<u>7.5YR 5/6 POCKETS (~1cm)</u> <u>NEAR TOP OF HORIZON</u>
<u>2C</u>	<u>150-170</u>		<u>SL</u>		<u>2.5YR 4/6</u>			<u>FR</u>		
<u>3Cg</u>	<u>170-180</u>		<u>SIC</u>		<u>10YR 6/2</u>	<u>F2P</u>	<u>7.5YR 5/6</u>	<u>VF1</u>		
Additional Notes <u>FEW PEBBLES THROUGHOUT MOSTLY LESS THAN 2CM</u>										
<u>CONCENTRATION OF GRAVEL UP TO 5CM AND IRONSTONE UP TO 20CM IN</u>										
<u>TOP OF Rx; Rx IS VERY MARGINAL</u>										

SOIL DESCRIPTION

Client _____ Job No. 88438 Described By DPW Date 3/8/88

Observation No.		Type		Location <u>TEST PIT 4</u>						
Map Symbol		Classification					Series			
Landscape Position							Parent Material <u>COASTAL PLAIN SEDIMENTS</u>			
Slope <u>4-5%</u>		Relief		Drainage			Water Table			
Vegetation										
Horizon	Depth CM	Boundary	Texture	Structure	Color	Mottling		Consistence	Rx.	Other Features
Ap	0-19	AS	LS	OM	10YR3/3			VFA		UPPER 5 CM 10YR2/2
E	19-36	CS	LS	OM	10YR5/6			VFA		
BE	36-49	CS	LS	1MSBK	10YR5/6 AND 10YR4/6			VFA		
Bx	49-76	CS	SL	1COSBK	10YR4/6			FR		PATCHY CLAY FILMS ON SOME PED FACES
C	76-120		S	OSC	10YR5/6			L		~10% GRAVEL
2C	120-150		SL		7.5YR6/6			FI		
3C	150-170		L, CL		5YR6/6	M2P	10YR6/2	FR, FI		
Additional Notes <u>18% SLOPE ~ 60' WEST</u>										

SOIL DESCRIPTION

Client _____ Job No. SS438 Described By DPW Date 3/8/88

Observation No.		Type		Location		PIT 6 S SIDE				
Map Symbol		Classification		Series						
Landscape Position				Parent Material						
Slope		Relief		Drainage		Water Table				
Vegetation										
Horizon	Depth cm	Boundary	Texture	Structure	Color	Mottling		Consistence	Rx.	Other Features
Ap	0-23	AS	LS	OM	10YR3/3			VFR		
BE1	23-36	CS	LS	OM	7.5YR4/6			VFR		
BE2	36-73	CS	LS	OM	5YR4/6			VFR		
BE3	54-73	CS	LS	OM	7.5YR4/4			VFR		GRAVEL + IRONSTONE LENS
Bx?	73-97	CS	LS	IMSBK	5YR4/6			VFR		B BODIES
C	97-111		S	OSG	5YR4/6			L		
Additional Notes										

SOIL DESCRIPTION

Client _____ Job No. 88438 Described By DPW Date 3/8/88

Observation No.	Type	Location <u>PIT 6 N SIDE</u>
Map Symbol	Classification	Series
Landscape Position	Parent Material	
Slope	Relief	Drainage
Water Table		
Vegetation		

Horizon	Depth CM	Boundary	Texture	Structure	Color	Mottling		Consistence	Rx.	Other Features
Ap	0-31	AS	LS	OM	10YR3/3			VFR		
BE1	31-53	CS	LS	OM	7.5YR4/6			VFR		
BE2	53-72	CS	LS	OM	7.5YR5/6			VFR		
BE	72-106	CS	SL	1M5BK	7.5YR4/6			FR		
C	106-113		LS	OM	5YR3/8			VFR		

Additional Notes